MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2021/2022

ECE2056 – DATA COMMUNICATIONS AND NETWORKING

(ALL GROUPS)

9 AUGUST 2022
9:00 a.m – 11:00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages including cover page with 4 Questions only.
2. Attempt **ALL** Questions. The distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.

Question 1 (25 marks)

(a) Describe the THREE elements of a data communications protocol. [6 marks]

(b) Describe the process of piggybacking and its advantages. [2 marks]

(c) A small start-up company would like to set-up a new network consisting of seven (7) devices. The company has sought your advice on which network would be suitable if one of the connection fails. For each of the following four options, discuss the consequences if a connection fails.

(i) Seven devices arranged in a mesh topology. [2 marks]
(ii) Seven devices arranged in a star topology (not counting the hub). [2 marks]
(iii) Seven devices arranged in a bus topology. [2 marks]
(iv) Seven devices arranged in a ring topology. [2 marks]

(d) Briefly explain the following protocols:

(i) Address Resolution Protocol (ARP). [5 marks]

(ii) High-level Data Link Control (HDLC) protocol. [4 marks]

Continued...

Question 2 (25 marks)

(a) (i) Define channelization and list three protocols in this category. [3 marks]

(ii) Compare and contrast a random access protocol with a channelizing protocol. [3 marks]

(iii) Figure Q2a(iii) shows three wireless nodes communicating with each other using a random access protocol. Name the collision problem that may arise and briefly describe how it occurs. How is this problem resolved in practice? [5 marks]

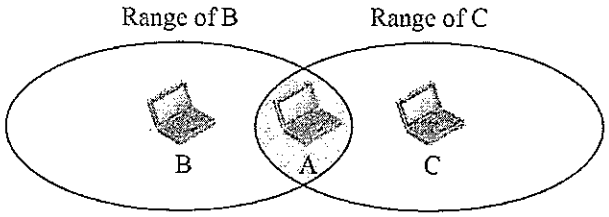

Figure Q2a(iii)

(b) Station A starts sending a frame of 1500 bits at time t = 0. The first bit of the frame arrives at Station B at time t_1 = 15 μs. Station B starts sending a frame at time t_2 = 5 μs. The data rate is 10 Mbps, while the signal propagation speed is 2×10^8 m/s. The network uses the carrier-sense multiple access with collision detection (CSMA/CD) protocol for access control.

(i) Calculate the frame duration. [1 mark]

(ii) Calculate the distance between Station A and B. [2 marks]

(iii) Calculate the number of bits sent by Station A before it detects the collision. [2 marks]

(c) In order to avoid collision, carrier-sense multiple access with collision avoidance (CSMA/CA) has a feature called the Network Allocation Vector (NAV). With the aid of time-space diagram, explain the function of NAV in wireless local area networks. [6 marks]

(d) Figure Q2(d) shows an Ethernet without bridging. Sketch a bridged version of this Ethernet by dividing it into four domains each serving three stations. [3 marks]

Figure Q2(d)

Continued...

Question 3 (25 marks)

(a) The Internet Protocol (IP) is an important network layer protocol that enables host-to-host delivery and routing.

(i) Is IP a reliable or unreliable protocol? Justify your answer. [2 marks]

(ii) Is IP a connection-oriented or connectionless protocol? Justify your answer. [2 marks]

(iii) IPv6 by default is the network addressing use nowadays. List four (4) improvement features of IPv6 as compared to IPv4. [4 marks]

(b) A classless IP address is given as 202.1.1.84/26.

(i) How many host addresses are available in the network? [1 mark]

(ii) Determine the first address in the network. Show your working. [2 marks]

(iii) Determine the last address in the network. Show your working. [2 marks]

(c) A company is assigned the IP address of 202.32.10.0/25. Design an IP addressing scheme with subnetting that can accommodate 6 subnets with 15 usable hosts in each subnet.

(i) Determine the number of bits that must be borrowed from the Host ID in order to accommodate the 6 subnets. [1 mark]

(ii) What is the number of bits that must be reserved to accommodate the 15 hosts? [1 mark]

(iii) What is the subnet mask used? [2 marks]

(d) A company network has 3 locations of A (main HQ) and remote systems at locations B and C, and it is connected to each other via MPLS network. As the network engineer, you are allocated a large block of IP address (202.188.1.0/24) for this company. The IP addresses is then subnet for location A with IP address (202.188.1.0/25) for 100 of users. For the two smaller remote locations of B and C, each location has only 40 users.

(i) If location A uses the IP address block (202.188.1.0/25), how many subnets available, and how many maximum hosts can A platform be assigned? Justify your answer. [4 marks]

(ii) What is the remaining block of IP addresses that can be used by the two smaller remote B and C locations? If you decided to further subnet 202.188.1.128/25 for two smaller remote platforms, how can you do it. Justify your answer. [4 marks]

Continued...

Question 4 (25 marks)

(a) Assume a Transmission Control Protocol (TCP) client expects to receive byte 3031, but it receives a segment with sequence number 3021. What is the reaction of the TCP client to this event? Explain the reason. [5 marks]

(b) (i) Describe why an application developer may choose to run its application over User Datagram Protocol (UDP) rather than Transport Control Protocol (TCP). [3 marks]

(ii) Explain why voice and video traffic is often sent over TCP rather than UDP in today's Internet. [2 marks]

(iii) Suppose two TCP connections are present over some bottleneck link of rate R bps. Both connections have a huge file to send (in the same direction over the bottleneck link). The transmissions of the files start at the same time. What is the transmission rate that TCP would like to give to each of the connections? [2 marks]

(c) Assume we need to design a Selective-Repeat sliding-window protocol for a network in which the bandwidth is 1 Gbps and the average distance between the sender and receiver is 5,000 km. Assume the average packet size is 50,000 bits and the propagation speed in the media is 2×10^8 m. Find the maximum size of the Send and Receive windows, the number of bits in the sequence number field (m), and an appropriate time-out value for the timer. [7 marks]

(d) Suppose a process in Host C has a UDP socket with port number 6789. Suppose both Host A and Host B each sends a UDP segment to Host C with destination port number 6789.

(i) Will both of these segments be directed to the same socket at Host C? [1 mark]

(ii) How will the process at Host C know that these two segments originated from two different hosts? [2 marks]

(iii) Suppose that a Web server runs in Host C on port 80 (http port). Suppose that this Web server uses persistent connections, and is currently receiving requests from two different Hosts, A and B. Are all of the requests being sent through the same socket at Host C? If they are being passed through different sockets, do both of the sockets have port 80? Discuss and explain. [3 marks]

End of Paper